AALTO UNIVERSITY SCHOOL OF BUSINESS

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The Impact of Automation and Robotization on Income Distribution in Post-industrial Countries: Who Are the Winners and What Steps Should Society Take?

Bachelor's Thesis

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Abstract

In this thesis, I study the effects of automation and robotization on income distribution and their effects on the society from a literary review point of view. The main effects of automation and robotization seem to be the added output and production, but at the cost of a more polarized income distribution towards the haves and have-nots. This tectonic shift in the work landscape might be something similar to the revolutions before, but it seems to be happening at a faster rate than the previous ones and this time effecting people from more varied backgrounds, even the top echelons of the income distribution seem to be getting hit. The most often proposed solutions to these problems are the implementation of strong taxation policies and the adoption of some form of Universal Basic Income (UBI).

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1. Introduction

Technological change has always caused despair and horror regarding imminent mass unemployment through new innovations being able to replace human labor at an ever-increasing pace. There has always been strong opposition to technological change when workers are scared for their livelihoods. The most well-known early example is that of the English textile workers protesting changes in their jobs in the so-called Luddite movement, by destroying automation machinery at their own workplaces in the early 19th century (Autor, 2015). These same concerns were raised throughout the last nearly two hundred years, almost every time new machinery was developed to do the tasks that used to be burdened by excess human labor. Most people don't seem to remember or even more so, mind the fact that agriculture used to employ 20 times the portion of people as today (41% of the US workforce in 1900 vs. 2% today (Autor, 2015)), or that horses used to do the jobs of cars before, thus eliminating the need for a plethora of equestrian occupations (Autor 2014). But nonetheless, during the time that those sectors were amid change, the workers and the society around them would be at arms over the scary future and the foreseeable loss of now extinct jobs.

Most of the bigger changes in workplace automation in the past has taken place for mundane and low-skilled manual tasks, which were mainly employing young or uneducated workers. This has largely benefitted those in the top and bottom parts of the income distribution, as the least productive jobs have been the easiest to automatize, their previous holders have generally either moved into other lower paying jobs or gone up a wrung on the income distribution ladder. Likewise, the ones at the very top have usually benefited greatly from the automatization of jobs, which they previously needed to pay someone to attend to constantly. This has however left the middle class without great changes to their ways of working, which in turn has caused a shift of sorts in the overall income distribution of countries. (Autor & Dorn, 2013.) Likewise, in some occupations and locations this has led to long term sustained unemployment.

During all of this, there is discussion about the 'impossibility of technological unemployment' as labor is being saved and that in change reduces costs and the price of the products or commodities being produced. Which "frequently leads to increases in output demand;

greater output demand results in increased production, which requires more labor, offsetting the employment effects of reduction in labor requirements per unit of output stemming from technological change." (Brynjolfsson and Mcafee, 2014), p. 81. This view extends out to garner that automation should therefore create more jobs than it destroys. It is mainly these two opposing views, that I try to pit against one another in this thesis, while attempting to view it in today's atmosphere of the ever-increasing speed of automation technology we are facing currently.

1.1 Comparing today's changes to previous ones

One of the most interesting difference with today's changes in comparison to those that have happened previously throughout history, is that today's changes affect a multitude of different social classes and a considerably more varied set of income and education background levels. Most commonly thought of "easy to automatize" sectors are being bunched together with sectors that were thought to be very hard to automate just a few years ago.

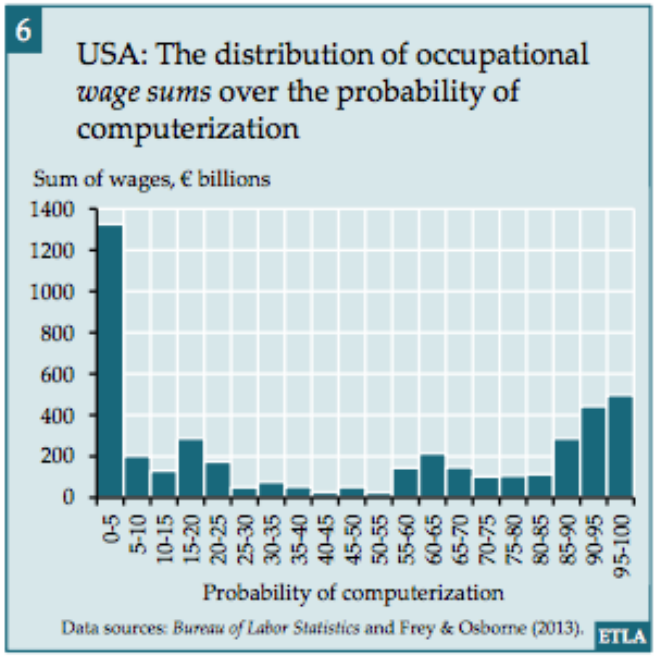
This is called the Moravec's paradox, which is defined by its author, Hans Moravec, in the 1980s as follows: "It is comparatively easy to make computers exhibit adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility." (Moravec, 1988), p 15. Meaning in more general terms, that computers are beginning to automate and make redundant plenty of jobs previously expected to remain in human control for a long time.

Such sectors include driving cars, which was expected to still take decades when the Defense Advanced Research Projects Agency, DARPA for short, issued its Grand Challenge for driverless cars in 2004, with the goal to accelerate the development of self-driving cars. In 2004 not a single car was able to compete their intended 150-mile course in the Mojave Desert and it was expected to take many decades until cars could safely be allowed to drive within human drivers. It took well under ten years for Google to start driving its self-driving cars on the roads in the US, in fact they announced in October 2010 that they had been testing self-driving cars on the roads already for some time. (Brynjolfsson & McAfee, 2014), p. 13. Similar courses of action have

taken place in the automation of many financial sector, legal, accounting and technical high level and very well paying jobs in general.

Moravec's paradox is only beginning to show itself in full force, as computers have gotten ever increasingly cheaper and more powerful. However, there are still plenty of tasks that most likely won't be going anywhere, for a multitude of reasons. Few are willing to fly on planes without pilots, even though it would objectively be considerably safer to do so. And just like Moravic's paradox states, computers will not be good at doing some tasks, even though they can beat humans quickly in others. A computer will not be quick to learn how to catch visual cues about people getting annoyed or frustrated, nor will they be too quickly replacing tasks that are done in conditions not exactly specifiable, such as picking up and folding towels or a job which requires its doer to be able to pick up various small objects from the ground for example. Even though these tasks are possible, they are still too random occurrences for the robots. The towel-folding robot takes hundreds of times longer to fold a towel, than its human counterpart, at least for now. (Brynjolfsson & McAfee), p. 92.

Figure 1.



Pajari & Rouvinen, Computerization Threatens One Third of Finnish Employment, ETLA Briefs, January 2014.

Pajari and Rouvinen (2014) discuss how today's changes in technological change are unique in its magnitude and speed, and how it might attest to rather high and sustained levels of

unemployment, due to quite severe job loss in comparison to the concurrent job creation from the ongoing technological shift and otherwise. They also continue with their analysis of the situation at hand and how it is likely to increase global welfare, although the effects to global geographical distribution as well as distribution within countries' as is, are yet to be seen. One option to counter the negative effects could be through education and schooling, or through various changes to tax schemes. One of which is the suggested *Universal Basic Income (UBI)*, which tends to come up almost always when looking farther into the future regarding automation.

1.2 Methods, Background & Findings

This thesis is a pure literary review of mainly modern literature, both books as well as scientific articles and papers. I will attempt to borrow relevant graphs and tables from the literature and base as much of the thoughts around these, but will attempt to refrain from delving too deeply into the underlying statistical analysis of said problems. A considerable amount of the literature discusses the likely divides in the economy, between those who will almost unanimously benefit from the changes at hand (stars & superstars) and those who cannot do much else than sit back and take the beating (have-nots) (i.e. Brynjolfsson & McAfee, 2012 & 2014, and Ford, 2016.)

In this bachelor's thesis, I will attempt to look into the problems Piketty brings up in his opus "Capital in the 21st century," of which the most interesting topic regarding this thesis is regarding the Return on Investment of capital/wealth (r) and growth of the economy (g) at large being out of tune with today's society's expectations regarding equality and a fair future of capitalism. I will also look into the possible governmental interventions that might be needed in the upcoming decades, should the situation regarding automation lead to societal problems due to a quickly polarizing wealth gap.

I will attempt to explain and resolve some of Piketty's views through largely those presented in Brynjolfsson and Mcafee's two books "Race Against the Machine" (2012) and "The Second Machine Age" (2014) and Martin Ford's views in his book "Rise of the Robots: Technology and the Threat of a Jobless Future" (2016). These books offer great explanations of the larger expected changes bound to happen due to mass automatization of jobs in the upcoming years. Especially the newer two books conceptualize the economic situation with upcoming superstars and the have-nots and how at some point due to economic realities literally all jobs that somehow

can be imagined to be automatable will be automated away, quickly. This will most likely also be supplemented with considerable automation of tasks that won't be automated for a long time, if ever, but can still be streamlined through automation of various tasks, such as driving workers around and letting them work while on the move, caused by the automatization of transportation.

This literature will be greatly contrasted by especially David H. Autor's work, who has written a multitude of papers in the fields of automation, robotization, income distribution and polarization of the workforce. Autor's papers are not the only scientific papers by any means, but perhaps the most influential ones to this.

It seems, that society will be even more polarized in the near future. In the longer term, there might need to be some sort of governmental intervention to help those who have been dislodged too far from comfort. One of the always suggested options is the possibility to implement some form of Universal Basic Income (UBI).

Society as a whole has benefitted greatly from the exponential computing power and those who have already mastered its' mysteries have been able to build up massive fortunes, the superstars. These systems have been quick to lay waste to complete sectors of labor, just as the car destroyed most of the equestrian occupations.

2. History of workplace automatization and the age of robotization.

Since the dawn of time, humans have attempted to automate most of the mundane, dangerous or dirty jobs to free up time to raise their offspring better or to spend their precious time working on more effective work. As a community gets i.e. a flour mill set up, they could then spend a great amount of newly acquired time working on other tasks, thus outputting considerably more than previously. This is the basis of the Solow-Swan economic growth model, and is considered as one of the pillars of all economic growth models in economics. Per the Solow-Swan growth model, all economic growth (in terms of GDP/Capita) in the long term comes from added productivity caused by technological advances.

Autor, Levy and Murnane (2003) distinguish two broad sets of labor that have been seen as very difficult to automate: the *abstract*, covering tasks requiring problem-solving, intuition, creativity and persuasion. And the *manual* which are characteristic of customer service jobs, such as food preparation, cleaning and elderly care. However, not even these looks to be too far from being in the crosshairs of common automation, these thoughts are rather like the ones presented in the Moravec's paradox.

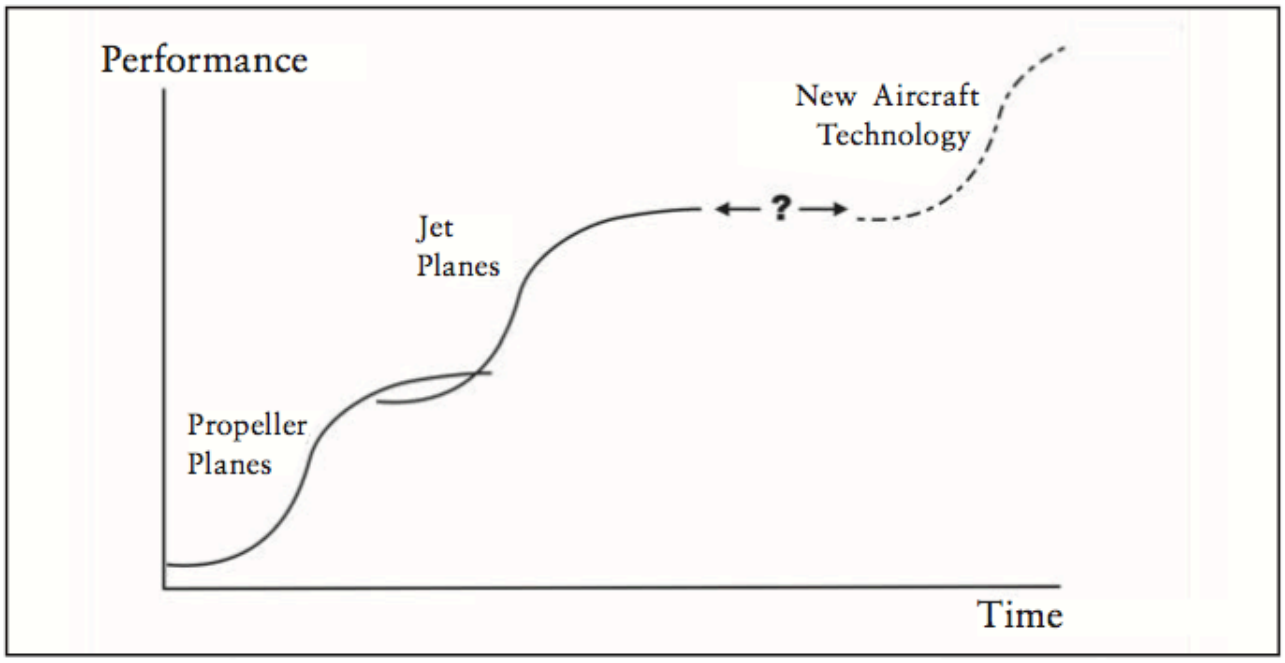
2.1 Moore's law and its effect on everything

The segment of technological progression encompassing computers, internet and telecommunications, has been full of various guesses at timelines, of which almost all have been somehow too conservative, either in the expected growth figures being too low, or then the expected outlook has been projected to last only a few years, not decades. The most famous of these is without doubt Moore's law, so named after its conceptor, Gordon Moore, the co-founder of Fairchild Semiconductor and Intel, who's paper "*Cramming more components onto integrated circuits,*" published in 1965, described the doubling of components per integrated circuit every year. In this paper Moore predicted that this rate of growth could continue for another decade, but later changed his estimate to the doubling happening every two years. Nowadays the period is often quoted as 18 months, and is only now seeming to reach Moore's prediction of happening every other year.

One can only wonder at all the superfluous things happening in a sector which is responsible for such a large part of our everyday wellbeing, while simultaneously experiencing real world exponential growth over multiple concurrent decades. No other technology, ever, has come close.

What we are more used to are various short S-curves, which oftentimes tend to be coupled to one another, such as the following graph with airplane technology from Martin Ford's 2016 book Rise of the Robots: Technology and the Threat of a Jobless Future. It shows and emphasizes the fact, that while airplane technology has grown considerably more robust, fast, safe, better in every measure, it still has only had a few major breakthroughs elevating it to a clearly superior level when compared to a previous status quo.

Figure 2. Aircraft Technology S-Curves

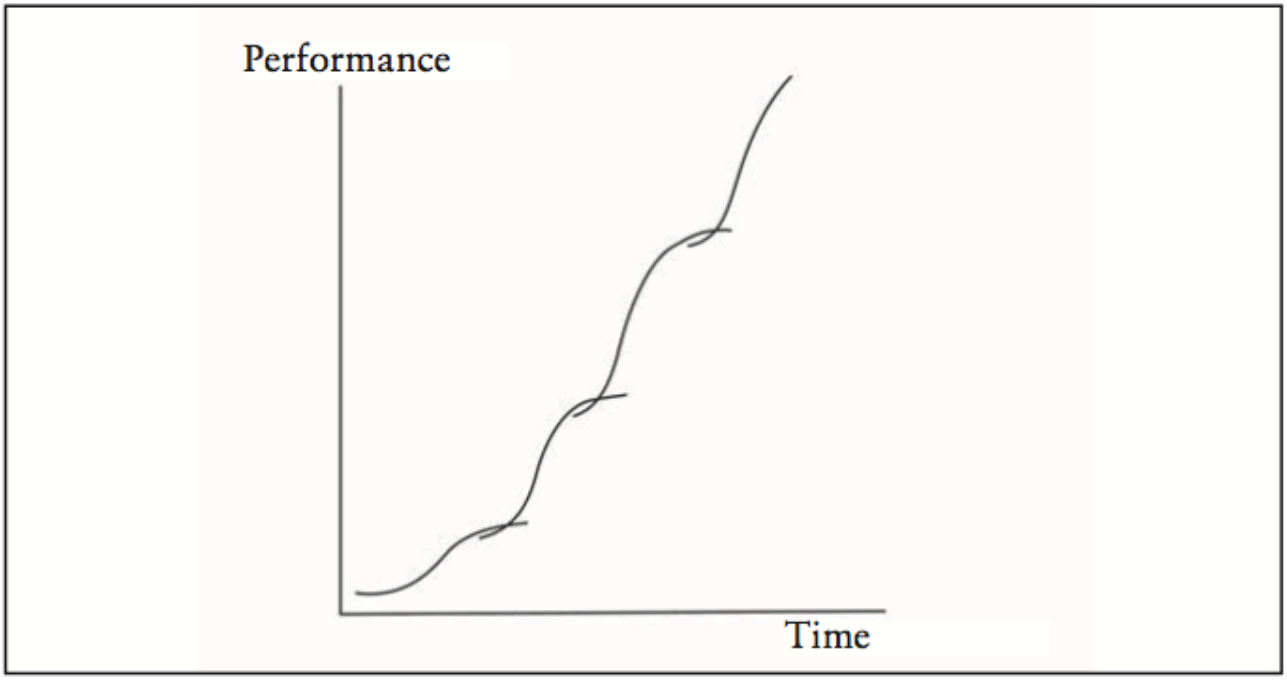


Martin Ford, 2016, Rise of the Robots: Technology and the Threat of a Jobless Future. p. 67.

Obviously, Moore's law isn't a law in the terms of legal law, nor is it a law in the sense of scientific laws, such as the four laws of thermodynamics. Neither is it necessarily a good idea in general sense to predict the future by greatly extrapolating from a somewhat short span of historical growth figures. It is still perhaps one of the greatest driving forces in the world of automation. Moore's law has been working due to constant R&D effort and small improvements on previous ways of doing things, "brilliant tinkering," finding detours around what had been

previously thought of as absolute roadblocks. First the engineers crammed circuitry as close as possible to one another and then came up with a solution to stack them on top of each other, to be able to cram even more into the same space and so on. It is truly remarkable, how exact it has been to predict the growth of a huge genre of electronics for so long.

Figure 3. Moore's Law as a Staircase of S-Curves



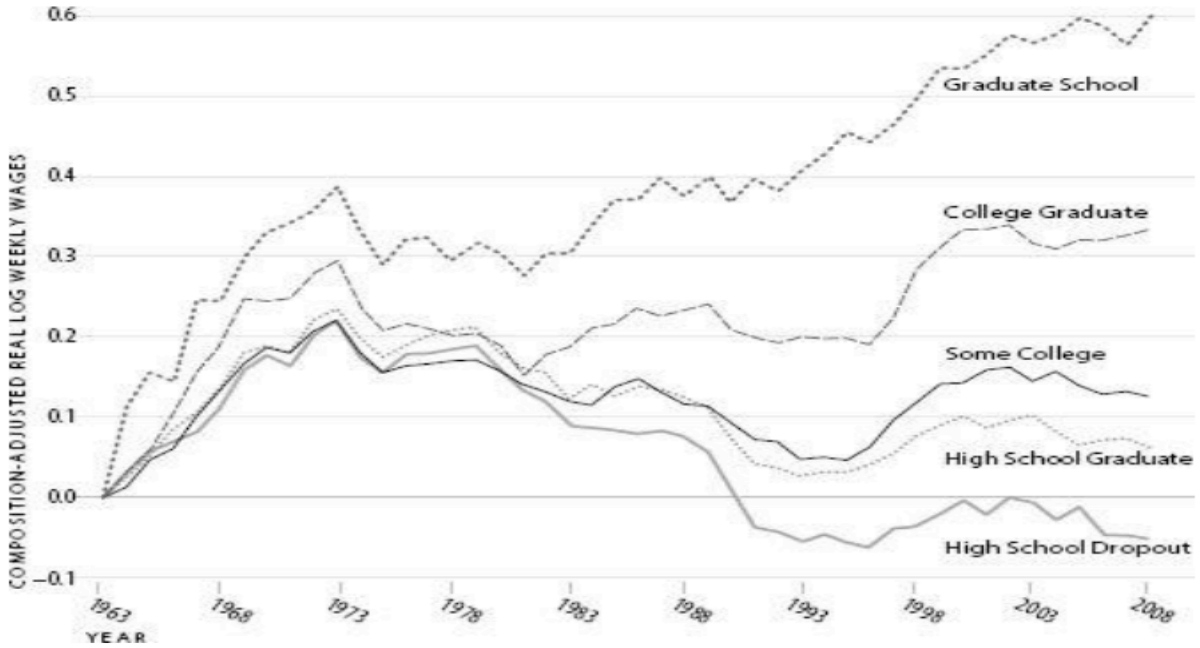
Martin Ford, 2016, Rise of the Robots: Technology and the Threat of a Jobless Future. p. 70.

The possibilities brought upon the owners of machinery, where the effectiveness continues growing at an exponential rate for decades at a time is something to marvel at. No other field ever has seen anything close to this. This combined with the winner takes all workings of the technology sector, has widened the gap between the haves and have-nots.

It is largely this growth, that has enabled the decoupling of median income per capita and the real GDP per capita, also called "The Spread" by Brynjolfsson and McAfee in The second Machine Age and has the 9th chapter named "The Spread."

Those, who have either owned the machinery or companies which could most benefit from technological automation naturally could partake in a unique growth in their personal wealth due to technological advance. But just as the owners of wealth have been able to greatly outpace the general population in wealth creation, so has the owners of human capital, the well-educated workers, as is apparent in the following graph.

Figure 4. Real GDP vs. Median Income per Capita (in the US)



Brynjolfsson & McAfee 2014, The Second Machine Age, p. 63.

2.2 Differences in today's workplace automation

The idea that technological change causes unemployment is in no ways a new one, even going back almost 200 years, but it is especially interesting now, as automatization is quickly replacing large amounts of not only unskilled and low income sectors, but also sweeping through the upper echelons of the income hierarchy. There is no agreed upon reason for current quite high levels of persistent unemployment in large parts of the developed world, but per Brynjolfsson & McAfee (2012) many scholars have pointed fingers at automatization and robotization as a possible explanation for the recent growth in joblessness.

Autor (2015), p. 27, stresses the importance of the adaptability of education to the changing needs of the workplace as a critical step towards surviving the possible apocalypse of a considerable portion of today's middle class jobs. The future will need a new sort of work force, which won't be one we can predict with much certainty today. Autor's conclusions include his predictions that the tasks of the future will have a hard time unbundling the many middle-class jobs without a considerable drop in quality and thus these jobs will most likely have to work alongside automated procedures. This does bring forward a possible new set of problems, as the current lower middle class occupant might not be suitable towards the new tasks which need to

combine both technical and interpersonal tasks as “the new artisans.” It is problems such as these, that absolutely must be addressed by education in the upcoming decades.

Brynjolfsson and Mcafee (2014, p 84) describe a thought experiment in their book about a future, where we could have self-replicating androids to work flawlessly, around the clock, and how they would rather quickly take over the entire work force as follows.

> *“*Imagine that tomorrow a company introduced androids that could do absolutely everything a human worker could do, including building more androids. There’s an endless supply of these robots, and they’re extremely cheap to buy and virtually free to run over time. They work all day, every day, without breaking down.
>
> Clearly, the economic implications of such an advance would be profound. First of all, productivity and output would skyrocket. The androids would operate the farms and factories. Food and products would become much cheaper to produce. In a competitive market, in fact, their prices would fall close to the cost of their raw materials. Around the world, we’d see an amazing increase in the volume, variety, and affordability of offerings. The androids, in short, would bring great bounty.
>
> They’d also bring severe dislocations to the labor force. Every economically rational employer would prefer androids, since compared t o t he status quo they provide equal capability at lower cost. So they would very quickly replace most, if not all, human workers. Entrepreneurs would continue to develop novel products, create new markets, and found companies, but they’d staff these companies with androids instead of people. The owners of the androids and other capital assets or natural resources would capture all the value in the economy, and do all the consuming. Those with no assets would have only their labor to sell, and their labor would be worthless. “

This quote is the most likely the most quoted from their book, and one that most easily drives home the interesting problems possibly caused by automatization. That quote was also one of the main drivers for me writing this thesis.

One can quite easily imagine the convergence of multiple humane and political problems caused by a situation such as the one explained above. Who would make sure everyone had enough to survive on? The world would be producing enough to fulfil all needs, but without some sort of redistribution of wealth or re-imagining of our society, many would suffer.

The most common suggestions to these problems in inequality would be a progressive

taxation of a multitude of different forms of wealth and capital, perhaps a land tax and a highly progressive income tax. (Piketty, 2014) Other realistic solutions might include the use of universal income or shorter work weeks. A final point, typically neglected in recent dismal prophesies of machine-human substitution, is that if human labor is indeed rendered superfluous by automation, then our chief economic problem will be one of distribution, not of scarcity (Autor, 2015) This causes a very interesting divide into the literature regarding this tectonic shift in automation and therefore in ownership of production facilities, as with less need for workers means controlling the factory grows to have crucially more importance over the output. Perhaps the most common solution for these problems tends to be the implementation of a Universal Basic Income. It is most interesting to see that UBI has acquired such a large ideological following, even before it has been truly tried on a large scale almost anywhere. Finland is one of the first countries to trial it, but even that is a small test run with 2,000 participants.

We must also take into consideration the fact, that prior to every other larger shift in workplace automation, the same kinds of predictions of mass unemployment have been cast, with not much to show for in their defence when looked at after the change occurring. Usually the change in jobs hasn't caused too much cause for alarm, but there has always been a transitionary period of technological unemployment in-between the stages.

2.3 Similarities to what has happened before

Obviously, the doomsday predictions can be avoided if job creation will offset the job destruction caused by the current wave of automation. This does however require the workers to be able to move into usually somewhat higher educated professions and in doing so at a massive scale, they should lower the wages in those fields due to sudden surge in supply in the work force. The other end of the spectrum are the highly paid, highly educated workers who might be facing a new threat from unemployment due to automatization of their careers. In this end of the spectrum, it is somewhat likely, that the now unemployed due to automation might need to take a lower paying job through perhaps sometimes a somewhat large career shift. (Brynjolfsson & McAfee, 2014), p. 92. As history has shown us, it tends to take people quite a long time to accept their fate before they are willing to even consider going down a rung on the income distribution ladder and

beginning over in a new field. Brynjolfsson and McAfee (2014) have argued that this might be amongst the reasons for the stagnating downturn in western economies during the ongoing recovery from the great recession.

Of course, the need for re-educating workers doesn't seem too likely to happen without at least some friction, as many professions require years of schooling so the education of the newly unemployed might take many years. Even if all of this was possible Autor (2014) argues that the new US work force has been lackluster in its ability to educate itself through the higher education curriculum when compared to previous generations. Especially the portion of men graduating from university in the US has almost halted to the 1975 levels. Luckily the share of women has grown considerably more, but even that is far from being able to fill the needed gap between lacking supply and growing demand. The poor level of existing education has been argued as a major limiting point to filling ongoing vacancies in the job market.

While a considerable amount of work can and most likely will be automated and offshored, a big part of the new and already existing jobs cannot and will not be taken away. Most often these jobs include some form of interaction and perhaps an emotional or one-on-one aspect to the job. These same demands for interaction frequently privilege face-to-face interactions over remote performance. (Autor, 2015) These kinds of jobs might include early education and elderly care, or a considerable part of the sales professionals, who might value face-time.

This revolution could be pitted against the revolutions before it, be it the invention of electricity or the railroad or the industrial revolution, all of which have greatly reshaped society around them. But There are lots of reasons why this time truly might be different.

Even though this time might be different, most likely it won't be that much different. Just like always previously, employers, entrepreneurs and society has been quick to adapt to the new rules and ways of working. If there is a high level of unemployment, usually labor gets to be cheap, and projects which previously might have been unattainable due to labor costs, suddenly become at least viable to attempt.

3. Likely effects of technological change on income distribution

Often computers tend to add beneficially towards most jobs' labor output, instead of merely replacing them. Just as Wikipedia saves days off of every year from people having to look up definitions from encyclopedias or Google saves hours off from every day by providing an easy way to look up information. Neither of these technologies has in any greater way replaced work, on the contrary, they have opened new fields of business and added vast amounts of wealth into the world, not just for their owners (Wikipedia is operated by the Wikimedia foundation and doesn't benefit its creators at all greatly in monetary terms) but for everyone with an internet connection through simply them using these services "for free."

As previously discussed, the coming of robots looks to add at least some negative aspects into people's lives by putting plenty of people out of work. But the situation isn't as clear cut as it would at first thought seem. Many workers like to imagine that their industry is somehow safe from automation, or that some subset of industries will be automated without it effecting others in the industry.

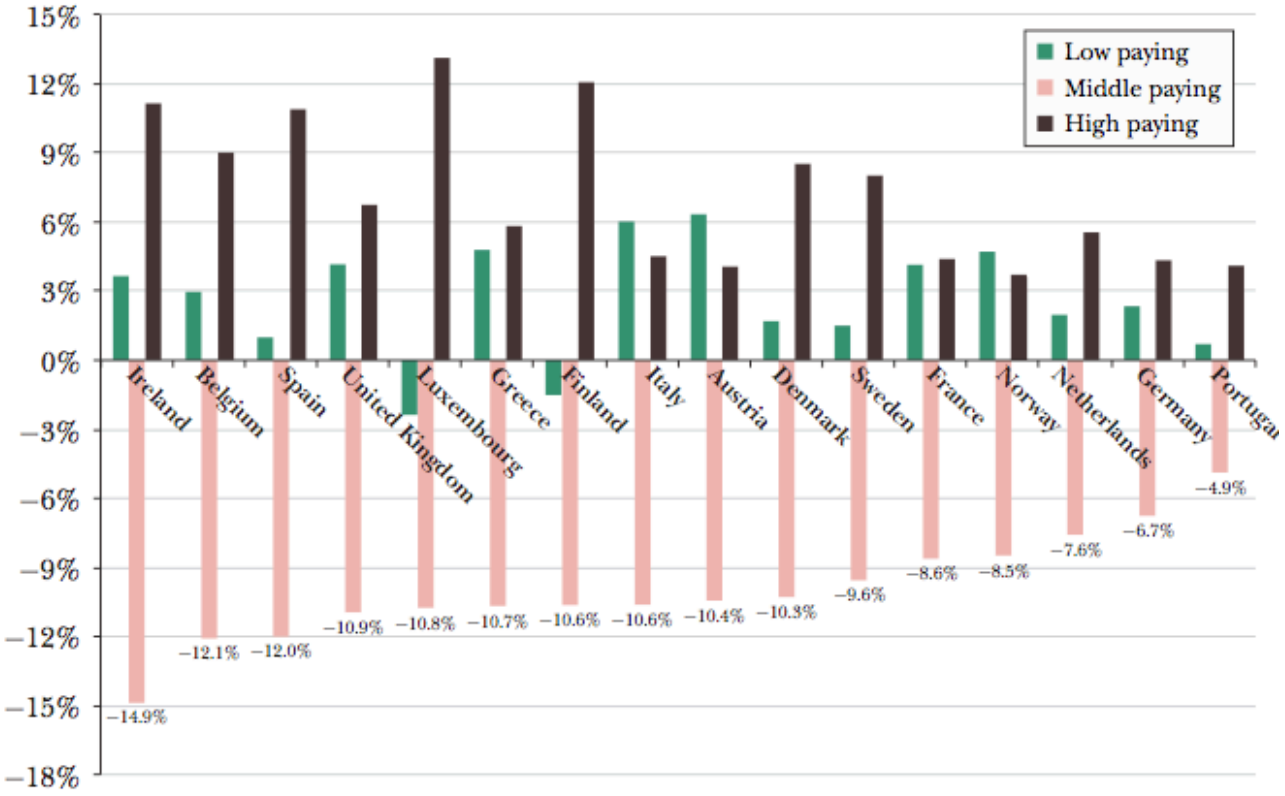
It seems to be true, that some segments of the population seem to be less at risk of having their jobs being automated away. But is this truly a good trait in the long run?

The middle classes have been rather unaffected by the changes so far. The most well off portion of the population is either owning the "machinery," and benefits through the cost savings and added production, or they have the best knowledge to work with, instead of against, new technology. Their jobs are often also less focused on one-on-one interaction, such as a nurses or shop clerks would be, and they can oftentimes be scaled to multiple people at once, especially with new technology.

The slightly surprising trend that has been noted previously in this thesis already, is that the lowest classes tend to have usually benefitted quite well from the automation technology as well. Brynjolfsson & McAfee (2014) write how the lowest paid production workers oftentimes can't go any lower and as their jobs get automated, many of them end up either on the same level they are at (where there usually is at least some work open) or end up overseeing the machines they used to operate, usually with a somewhat significant raise to go with it.

Figure 5.

Change in Occupational Employment Shares in Low, Middle, and High-Wage Occupations in 16 EU Countries, 1993–2010



Autor, 2015, Why Are There Still So Many Jobs? The History and Future of Workplace Automation. P.15.

As we can see from the graph above, the middle class seems to be disappearing at a rapid pace in the EU. In most cases, most of the middle-class jobs have moved into the higher class, but not always. And plenty of the middle-class jobs have always anyway moved to the lower classes, meaning people have been forced to take lower paying jobs then they previously held.

This is a difficult point for many, as not everyone has the needed skills to move on higher in the pay brackets. Without the needed skills and their jobs being taken over by robots, they have nowhere to turn but the lower paid jobs. When one compares this data to that of Figure 4, we can see a dark picture forming. Obviously the datasets are of different countries and the situation at large isn't quite the same in the EU as it is in the US, the US would fall somewhere in the middle of the pack in Figure 5.

3.1. The haves and have nots

As we have already witnessed, the age of rapid automation seems to quite largely favor the superstars at the very top, with not much care given to those who are not up to par to deal with the ever-faster changes to the work environment around them. It has been noted as well, that the society around us has been getting more and more accustomed to the idea of superstars having earned their super-pays. (Brynjolfsson & McAfee, 2014) Chapter 10.

Wealth tends to get distributed in an even more polarized way due to the winner takes all ecosystem of the technological age. If one robot or algorithm is a tiny fraction better or faster than the runner up, would that best one still take over basically the entire economy. There is simple no room for second best anymore. This makes life awfully difficult for the majority of players out there, as they do not even know the game the people at the top are playing. Most of the middle-class would most likely be fine with the way things are right now, with them getting to use the nice technological advances as the world moves on, but without much else on their plate really.

In the winner takes all economy, the owner of a winning company comes upon incredible amount of wealth, quite often by being able to automate the service which used to be carried out by many people previously. Just as previously a spinning jenny could automate the jobs of dozens or more people when it came out, can now TurboTax do the job of virtually limitless tax advisors. Although just as with the spinning jenny, do new technologies need people operating them, taking care of problems or bugs or edge-cases and developing them further. Still, it seems that the jobs lost tend to far outnumber the ones created by such progress.

All this automation of previously needed jobs will at some point cause serious problems if the job creation side doesn't end up growing faster than it is growing now.

4. Getting over the period of technological change

Autor (2013) argues that employment polarization won't continue forever, which is quite understandable. He also points out that even more of the middle-class jobs of the future will require a mixture of tasks from across the skill spectrum. This does give hope to the rise of the middle-class once again.

A crucial part of getting anyone back on their own two feet after their jobs have been outsourced or made extinct due to technological change rushing past them, has always been to re-educate the workforce so they are up to par in the new employment markets. Education has always been the main way through which we have got over technological changes in the past. Not just education of the newly unemployed, but largely education starting from childhood and continuing all the way up through the universities. This part of the education puzzle should be the simplest to solve as it already exists and at least *should* be subject to constant change in the winds of the constantly changing world in which it operates. The reality of the situation isn't quite as clear, especially in the ever-faster changes happening in the workplace around us, with even less predictability in the most in demand jobs of the future. What should we be teaching our children if don't have the slightest clue what they might need to do in a mere ten years? The sort of good news with this is the fact, that this isn't anything new to this generation of children, most people who were in the school system already at the turn of the millennia were faced with similar problems. Nobody could imagine for example social media or mobile technology to be this large before they existed for the masses.

In the short term there are big societal problems regarding the well-being of citizens. This has been brought up by nearly everyone I've cited so far in this text. Everyone tends to have their slight own twist as to what their personal remedy towards fixing the problem might be: Piketty (2014) suggest trying to curb the owning elite's grip of owning everything through more aggressive and assertive tax regimes. Ford (2016) talks about the need to implement universal income and the possibilities of long term change in the meaning of work and working in general. Autor (2013) reminds us that a good way to oftentimes curb the massive consolidation of wealth is to raise the minimum wage, thus automatically lowering the return on investment in high employing fields. This does however backfire quite quickly once a considerable amount of the workforce has already been laid off in preference for an automated robot army of employees. Once the train has been set in motion towards automatization, raising minimum wages will most likely merely fasten the

adaption of robots in the work place, as the heightened labor costs make the initial vast investments towards automatization even more worth it.

4.1. About Universal Basic Income (UBI)

UBI is discussed in length in both the Rise of the Robots (Ford, 2016) and the Second Machine Age (Brunjolfsson & McAfee, 2014) and this topic is based mainly a dialogue on their observations on the topic. UBI is a fascinating topic that ties together basically all literature I have come across this topic so far. It is of great interest to anyone studying these topics with a slightly longer time frame, as a world where most, if not all, work is being done by robots is really not only science fiction anymore. I am in no way trying to guess on the probability of this scenario, but it has grown to the point that UBI is on everyone's lips.

From an economics point of view, UBI is quite interesting in the sense that it is quite literally "helicopter money," in a sense because it would be cash that would be given to everyone. Clearly this "helicopter money," could be offset by tax schemes and the like to remove the added inflationary elements of it, but it still is rather different from what most nations are used to.

The basic principles of most Universal Basic Income –schemes are that everyone, regardless of their need for such assistance, would be receiving a fixed amount of money from the government monthly. Other proposed solutions have been to fund a "megafund" of sorts, and give every citizen a part of that, or to simply transfer cash to one's own bank account when they reach maturity, but these haven't been quite as popular in the later years.

Great things about the idea of a unified basic income scheme would be its simplicity, no more need for the amounts of bureaucrats and the fact that it wouldn't create harmful obstacles to entry regarding employment. It would be automatically self-regulating to a degree and it could be fine-tuned quite simply throughout. A somewhat of a good thing (more on this next) is that it doesn't have to be very strongly ideologically driven, it has quite many supporters on all sides of the political sphere.

Negatives on the other hand would be its quite vocal opposition on all sides of the political landscape. The right says it's socialism and would lead to ever more socialism, either through UBI being too simple to adjust up or then through other alternatives. The left is scared for the public-sector jobs and the needs based systems in place now, UBI would be too easy to tone down to the point that it wouldn't provide a livable wage.

A somewhat of a big problem with implementing UBI is its cost. It would need to be funded by taxes, but what should be taxed for optimal performance? There have been talk of such radical ideas as to tax the work robots and algorithms do. But more likely the taxed asset would be profits or wealth of one form or another. It is also a system that hasn't been tried and tested anywhere in a large enough scale and scope, that one could be sure as to what would happen to the economy once something this large is changed.

However, this is quite a complex political decision and topic and as always with politics, nothing difficult ever gets pushed through unless it absolutely must happen. It is likely that UBI would only get implemented quite quickly as a last resort option and would need to be readjusted as it is already in place. The change is too big for any politician to be willing to take such a risk for their careers with having another option on the table.

5. Conclusion

The nature of work is changing, whether we want it to or not. What we can do, is brace for impact and prepare for the aftermath. Overall it looks like there shouldn't be many other alternatives to a splendid future of plenty, if humanity can take care of the planet and its' citizens. In the short term however, we can end up in quite a pickle with massive technological unemployment and large sections of the population without means to support themselves.

It looks like the government and politicians would need to be involved in these changes. Tax-schemes and welfare needs need to be relooked at. The future might be of such extravagant plenty, that it would be mainly a problem of deciding how to split all that between the citizens in a fair manner.

The largest winners of the wave of robotization will without doubt be the superstars of today and tomorrow, the ones most capable of wielding the technology and the ones who hold the most capital in general, both wealth and information. While overall the output of most economies should skyrocket like never before, its bounty will most likely not be split up evenly. There will be fat tails on both sides of the distribution, of people falling considerably behind or way ahead of the mean.

This should benefit the entrepreneurial and might lead to greater risk taking and maybe even innovations that wouldn't otherwise get researched, but it looks like these benefits would be split up between an even smaller circle of elites' as do today.

These problems could be fought through taxation of wealth, land or income, as suggested by Piketty (2014). Or they could be fought against with a robust Universal Basic Income (for example Ford, 2016) or even higher minimum wages (Autor & Dorn, 2013), although this might merely fasten the timeline towards the automation of these low wage sectors.

It's important to remember, that similar ideas to these have been brought up multiple times every generation as new technologies emerge and disrupt the safe and sound ways of doing business. So far the capitalist society has been able to sort out the disruptions without much harm to anyone, but this time might be different. Probably it won't be, hopefully it won't be, but we should be prepared for the change to cause radical disruptions. Nobody's been sorry for being prepared.

References

Autor, D. H., & Dorn, D. (2013). The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review, 103*(5), 1553–1597.

Autor, D. H. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation, *Journal of Economic Perspectives – Volume 29, Number 3, Summer, p. 3-30.*

Autor, David H. (2014) "Skills, Education, and the Rise of Earnings Inequality among the 'Other 99 Percent.'" *Science 344(6186): 843–51.*

Autor, David H., Frank Levy, and Richard J. Murnane. (2003) "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics 118(4): 1279–1333.*

Brynjolfsson, Erik and Andrew Mcafee. (2012), "Race Against the Machine", *The MIT Centre for Digital Business.*

Brynjolfsson, Erik and Andrew Mcafee. (2014), "The Second Machine Age", *WW Norton and Company, New York.*

Ford, Martin. (2016) Rise of the Robots: Technology and the Threat of a Jobless Future, *Basic Books.*

Frey, C. B., & Osborne, M. A. (2013). "The Future of Employment: How Susceptible are Jobs to Computerisation?", *OMS Working Papers, September 18*.

Moore, Gordon E. (1965). "Cramming more components onto integrated circuits", *Electronics, Volume 38, Number 8, April 19, 1965.*

Moravec, Hans . (1988), "Mind Children", *Harvard University Press*

Pajari, M. & Rouvinen, P. (2014) "Computerization Threatens One-Third of Finnish and Norwegian Employment.", *ETLA Briefs, 22, January 13.*

Piketty, Thomas. (2014), "Capital in the Twenty-First Century", *The Belknap Press of Harvard University Press, Cambridge, Massachusett.*